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TRANSLATION FROM JAPANESE

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(54) [Title of the Invention] **Polyolefin Fiber With Durable Hydrophilic Properties**

(57) [Summary]

[Object] To offer a polyolefin fiber that possesses durable hydrophilic properties, is suitable for mass production, and is not a health hazard during fiber production.

[Structure] A polyolefin fiber, characterized by comprising a polyolefin Y and a hydrophilic copolymer X that consists of three or more components, contains at least 10 mol% ethylene, and has a b value of 10 or greater and a b/(a + b) value that ranges from 0.11 to 0.89, where b is the vinyl alcohol content (in mol%) and a is the vinyl acetate content (in mol%).

[Claims]

[Claim 1] A polyolefin fiber that possesses durable hydrophilic properties, comprising a polyolefin Y and a hydrophilic copolymer X that consists of three or more components, contains at least 10 mol% ethylene, and has a b value of 10 or greater and a b/(a + b) value that ranges from 0.11 to 0.89, where b is the vinyl alcohol content (in mol%) and a is the vinyl acetate content (in mol%).

[Detailed Description of the Invention]

[0001]

[Field of Industrial Utilization] The present invention relates to a polyolefin fiber that has durable hydrophilic properties.

[0002]

[Prior Art] The cost-related and physical features of polyolefin fiber are utilized in a variety of applications. The range of applications is limited, however, because of the strong hydrophobic properties resulting from the polymer structure. A strong need therefore exists for improvements in hydrophilic properties aimed at expanding the range of applications, and numerous attempts have been made in the past to render the fiber hydrophilic. Examples of methods for rendering a polyolefin fiber hydrophilic include (a) depositing a hydrophilic compound on the fiber surface, (b) graft-polymerizing a hydrophilic compound onto the fiber surface, (c) forming hydrophilic groups on the fiber surface by treating the fiber with a chemical, ultraviolet radiation, low-temperature plasma, or the like, and (d) forming hydrophilic compounds inside the polymer.

[0003] Examples of method (a) include a method in which a porous membranous article composed of polypropylene is treated with an anionic surfactant containing at least one type of base, such as a sulfuric acid ester base, phosphoric acid ester base, or sulfonic acid base (Japanese Laid-Open Patent Application 54-153872), and a method in which a fatty acid monoester of sorbitan is dissolved in an organic solvent to treat a microporous hydrophobic membrane composed of polypropylene or the like (Japanese Patent Publication 59-501049).

[0004]

[Problems Which the Invention Is Intended to Solve] The method described in Japanese Laid-Open Patent Application 54-153872 above as an example of method (a) fails to yield durable hydrophilic properties. The treatment method described in

Japanese Patent Publication 59-501049 requires the use of an organic solvent and thus presents problems in terms of handling or health safety. Methods (b) and (c), on the other hand, are disadvantageous because of their poor productivity, the need for special equipment, inadequate hydrophilic properties, and the like. Furthermore, no hydrophilic compounds develop sufficient hydrophilic performance in method (d).

[0005] An object of the present invention is to offer a polyolefin fiber that possesses durable hydrophilic properties, is suitable for mass production, and is not a health hazard during fiber production.

[0006]

[Means Used to Solve the Above-Mentioned Problems, and Effect of the Invention] As a result of painstaking research aimed at overcoming the shortcomings of the treatment methods (a) through (d) described above, the inventors devised the present invention after discovering that a polyolefin fiber that possesses durable hydrophilic properties can be obtained by forming a fiber from a polyolefin to which a specific hydrophilic polyolefin has been blended. The essence of the present invention resides in a polyolefin fiber characterized by comprising a polyolefin Y and a hydrophilic copolymer X that consists of three or more components, contains at least 10 mol% ethylene, and has a b value of 10 or greater and a $b/(a + b)$ value that ranges from 0.11 to 0.89, where b is the vinyl alcohol content (in mol%) and a is the vinyl acetate content (in mol%).

[0007] Examples of the polyolefin that serves as a constituent component of the fiber of the present invention include polyethylene, polypropylene, poly(3-methylbutene-1), and poly(4-methyl-pentene-1).

[0008] It is unsuitable for the hydrophilic copolymer X of the present invention to contain less than 10 mol% ethylene, because in this case the copolymer X and the polyolefin Y have zero mutual compatibility, a domain layer forms on said copolymer X, and the polyolefin fiber does not display sufficient hydrophilic properties. Nor is it suitable for said copolymer X to contain less than 10 mol% vinyl alcohol, because in this case the polyolefin fiber does not display sufficient hydrophilic properties. It is therefore possible to improve the compatibility of said copolymer X and polyolefin Y and to maintain satisfactory adhesion between said copolymer X and polyolefin Y by keeping the $b/(a + b)$ value within a range of 0.11 to 0.89 (where a is the vinyl acetate content, in mol%) under conditions in which the copolymer X

contains at least 10 mol% ethylene and the vinyl alcohol content (b value) is at least 10 mol%.

[0009] The polyolefin fiber of the present invention consists of a polyolefin Y/hydrophilic copolymer X blend polymer containing 50 to 95 wt% polyolefin Y and 5 to 50 wt% hydrophilic copolymer X. When the content of the hydrophilic copolymer X is less than 5 wt%, the fiber fails to display satisfactory hydrophilic properties. When the content of the hydrophilic copolymer X exceeds 50 wt%, it becomes difficult to make the material into a fiber.

[0010] The proposed polyolefin fiber that possesses durable hydrophilic properties is obtained by melt-spinning or drawing the aforementioned polymer.

[0011]
[Practical Examples] The present invention will now be described in further detail through practical examples. As used herein, hydrophilic properties were evaluated by manufacturing paper by hand and using two methods to determine water penetration and water permeability. Water penetration was evaluated by dropping a single water droplet with a pipet onto handmade paper manufactured on a trial basis, and visually determining the time needed for the water droplet on the paper to be absorbed and for the sheen produced by incident light to disappear.

[0012] Water permeability was evaluated by placing a piece of handmade paper manufactured on a trial basis on a cotton mill pulp, dropping a single water droplet with a pipet, and visually determining the time needed for the droplet to spread across the surface of the paper.

[0013] Durability was determined by washing test paper ten times in accordance with the JIS L-0217-103 method and measuring water penetration and water permeability after the ten cycles to evaluate the performance.

[0014] Practical Example 1

30 weight parts of an ethylene/vinyl alcohol copolymer that had an ethylene content of 32 mol% and was obtained by a common method was introduced into a reaction containing 40 weight parts water, 200 weight parts glacial acetic acid, and 10 weight parts 10 N hydrochloric acid, and a reaction was then conducted for 4 hours

at a temperature of 40°C, yielding a copolymer of ethylene, vinyl alcohol, and vinyl acetate (hydrophilic copolymer X). The molar ratio of ethylene, vinyl alcohol, and vinyl acetate in said copolymer X was 32:44:24; the b/(a + b) value, 0.65.

[0015] The hydrophilic copolymer X and a high-density polyethylene ("Hizex 2200J"; manufactured by Mitsui Petrochemical) were kneaded in a molten state in a ratio of 20:80 (weight parts) using a biaxial extruder, made into pellets, and dried.

[0016] The resulting pellets were fed to a spinning machine, spun at a spinning temperature of 180°C and a discharge rate of 12.5 g/min from a 20-nozzle spinneret with a nozzle diameter of 1.0 mm, and wound into a bobbin at a spinning rate of 350 m/min. The resulting undrawn yarns were drawn to a drafting degree of 240% at a drawing temperature of 70°C using a drawing machine designed for stapling purposes, and cut to a size of 3 mm. The resulting fibers had a single-fiber fineness of 4.9 denier, a tensile strength of 3.43 g/d, and an elongation in tension of 40.6%.

[0017] 80 wt% of said drawn yarn was mixed with 20 wt% of low-density polyethylene fiber with a single-fiber fineness of 2.5 denier and a fiber length of 3 mm, a pulp was prepared using an angular tabby papermaking machine, and fiber paper was produced. The product was then dried for 1 minute at 115°C on a "ferro" plate heating cylinder of the Yankee drier type, and bonding was performed, yielding handmade paper with a basis weight of 50 g/cm^2.

[0018] Hydrophilic properties were then evaluated, yielding the results shown in Table 1. The results indicate that the product possesses durable hydrophilic properties.

[0019] Comparative Example 1

High-density polyethylene ("Mitsubishi Polyethy JX-10"; manufactured by Mitsubishi Petrochemical) with a density of 0.958 g/cm^3 was spun and drawn under the same conditions as in Practical Example 1. The resulting fiber had a single-fiber fineness of 5.1 denier, a tensile strength of 4.35 g/d, and an elongation in tension of 43.3%.

[0020] Handmade paper with a basis weight of 50 g/cm^2 was manufactured under the same conditions as in Practical Example 1. Hydrophilic properties were then

evaluated, yielding the results shown in Table 1. The results indicate that the product does not possess durable hydrophilic properties.

[0021]

[Table 1]

	Initial		Following washing	
	Water penetration	Water permeability	Water penetration	Water permeability
Practical Example 1	21 s	24 s	22 s	24 s
Comparative Example 1	over 600 s	over 600 s	over 600 s	over 600 s

[0022]

[Merits of the Invention] As is evident from the above description, the present invention allows a polyolefin fiber with satisfactorily durable hydrophilic properties to be offered by blending a specific hydrophilic polyolefin into the base polyolefin.